GRANULAR AGGREGATE RESOURCES
OF SOUTHEASTERN NEW BRUNSWICK

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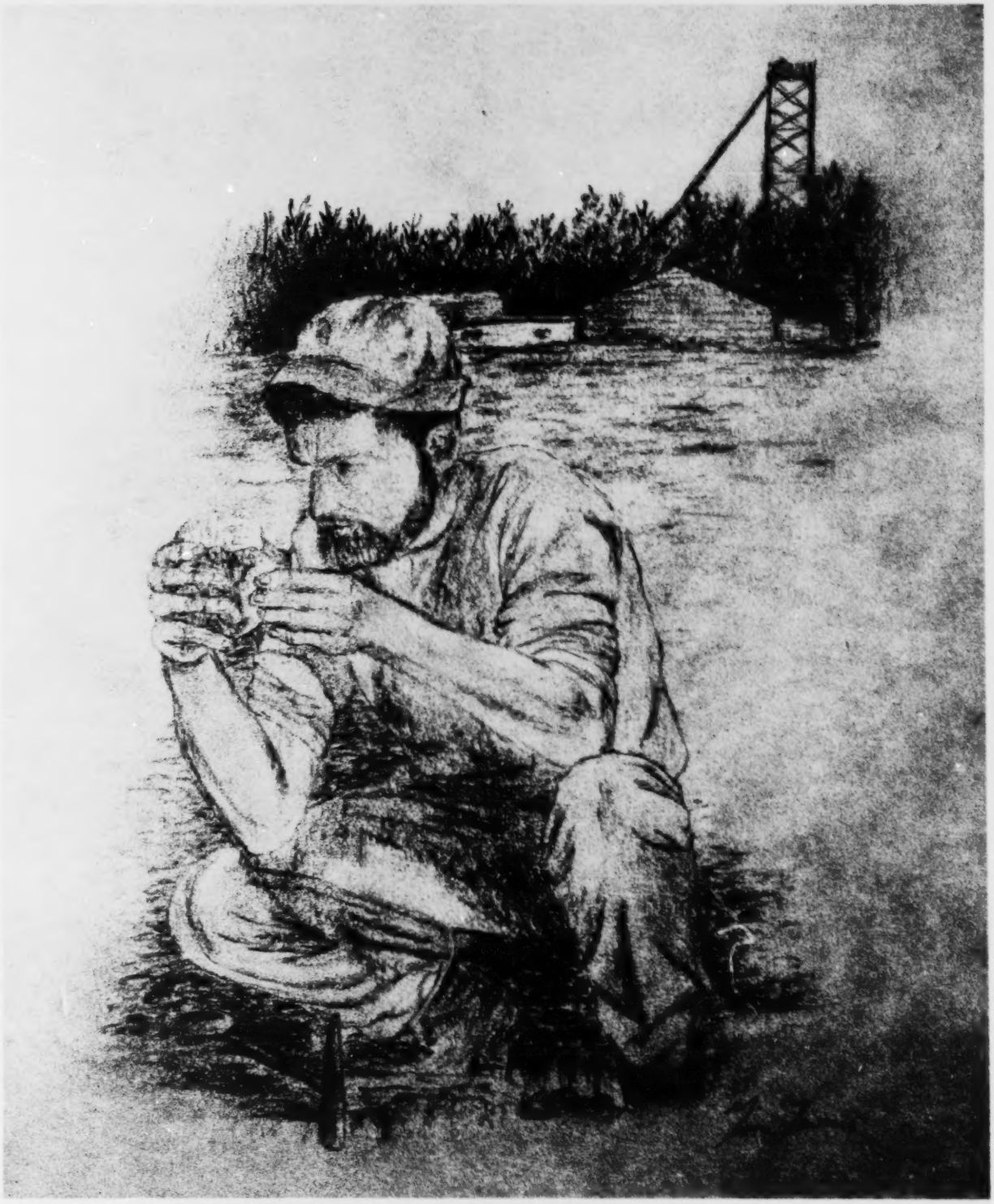

NATURAL RESOURCES AND ENERGY
NEW BRUNSWICK

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This report has been prepared by:

Mineral Resources Division
Department of Natural Resources & Energy
Province of New Brunswick

Hon. Malcolm N. MacLeod, Minister

1986

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SOUTHEASTERN NEW BRUNSWICK

Mineral Resources Division

Department of Natural Resources and Energy

New Brunswick

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ABSTRACT

The southeastern New Brunswick area suffers from an extreme paucity of quality granular aggregate materials. Workable reserves of fair to good quality material are estimated at 2 million m^3, and are all located in the southern half of the Hillsborough map area. Extensive quantities of very poor quality granular material, of limited practical value, are present in ablation moraines scattered throughout most of the area.

The scarcity of surficial granular materials has resulted in the extensive use of bedrock as aggregate: sandstone and conglomerate for low to moderate specification uses; and Precambrian granitic rocks and associated metasediments, for high specification uses.

RESUME

La région du sud-est du Nouveau-Brunswick souffre d'une pénurie extrême d'agrégats granulaires de bonne qualité. Les réserves exploitables d'agrégats de bonne qualité ou de qualité acceptable sont évaluées à deux millions de mètres cubes et sont toutes situées dans la moitié sud de la région de Hillsborough. Les moraines d'ablation que l'on retrouve un peu partout dans la région contiennent d'importantes quantités d'agrégats granulaires de très pauvre qualité et, par conséquent, d'une valeur plutôt négligeable.

La rareté d'agrégats granulaires en surface a forcé l'exploitation intensive du sous-sol rocheux. On utilise le grès et le conglomérat lorsque les exigences sont faibles ou modérées; ou le granite précambrien et ses métasédiments lorsque les exigences sont élevées.

INTRODUCTION

LOCATION AND ACCESS

The study area is located in southeastern New Brunswick (Figure 1), and covers an area of approximately 3,500 km^2. It lies between latitudes 45°45'N and 46°15'N, and is bounded to the west by longitude 65°00'W, and to the east by the Province of Nova Scotia and the waters of Baie Verte and Northumberland Strait. It encompasses five 1:50 000 scale NTS map areas (Figure 2).

Access within the area is via a number of interconnecting Provincial highways, including the Trans-Canada Highway, plus a network of local roads and some logging roads. Access to the few significant granular aggregate deposits is good.

PREVIOUS WORK IN THE AREA

Aspects of the regional surficial geology of the study area were first described by Chalmers (1885, 1890, 1895) in his early work on the surficial geology of New Brunswick. Reconnaissance surficial geology mapping of the Moncton map area and parts of the Hillsborough and Port Elgin map areas was carried out by Lohse (1974a, b, c, d, e). More recently, Quaternary geology mapping of the area was completed at the 1:250 000 scale by Rampton and Paradis (1981a, b). In

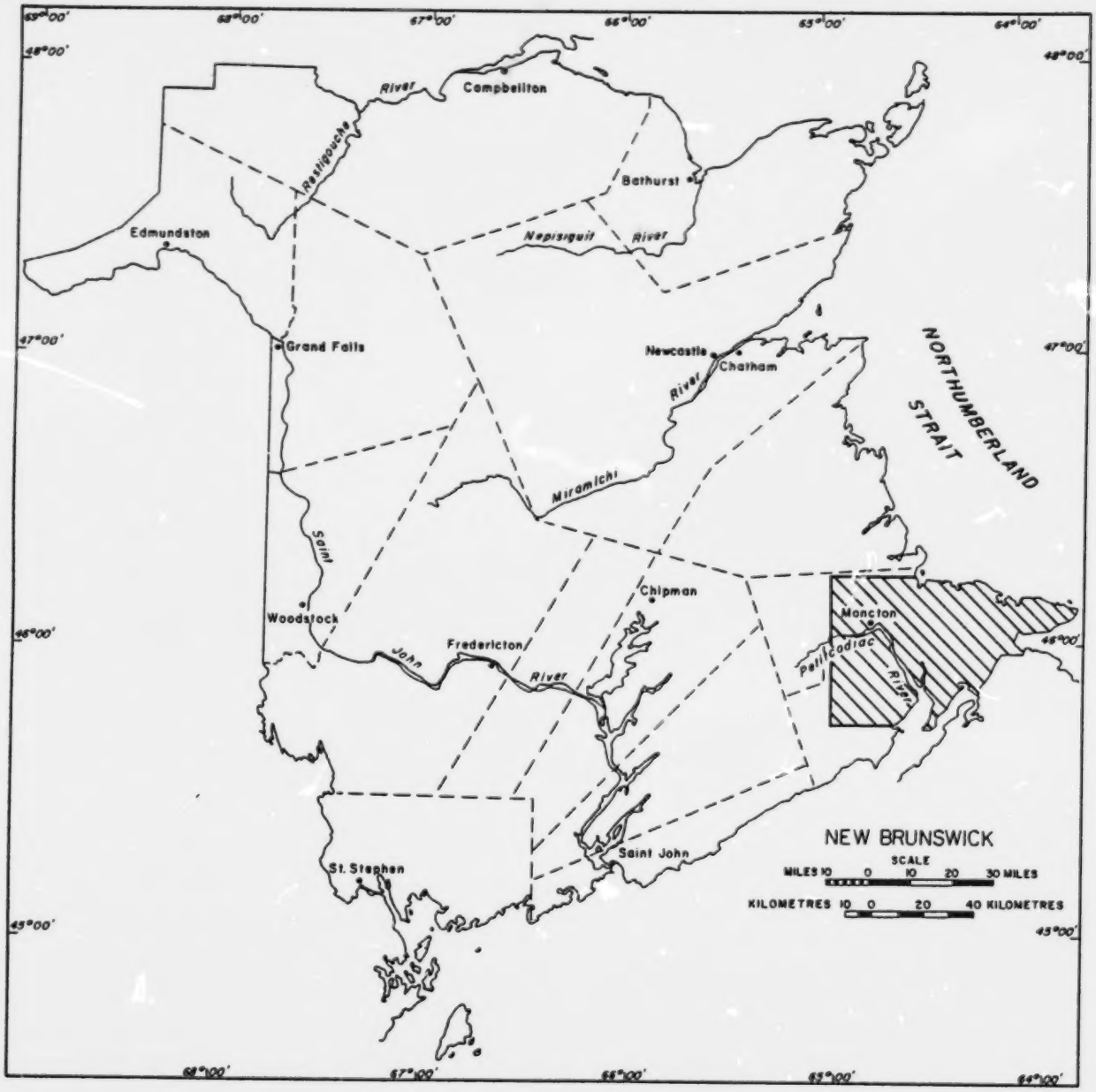

Figure 1. Location map of the study area

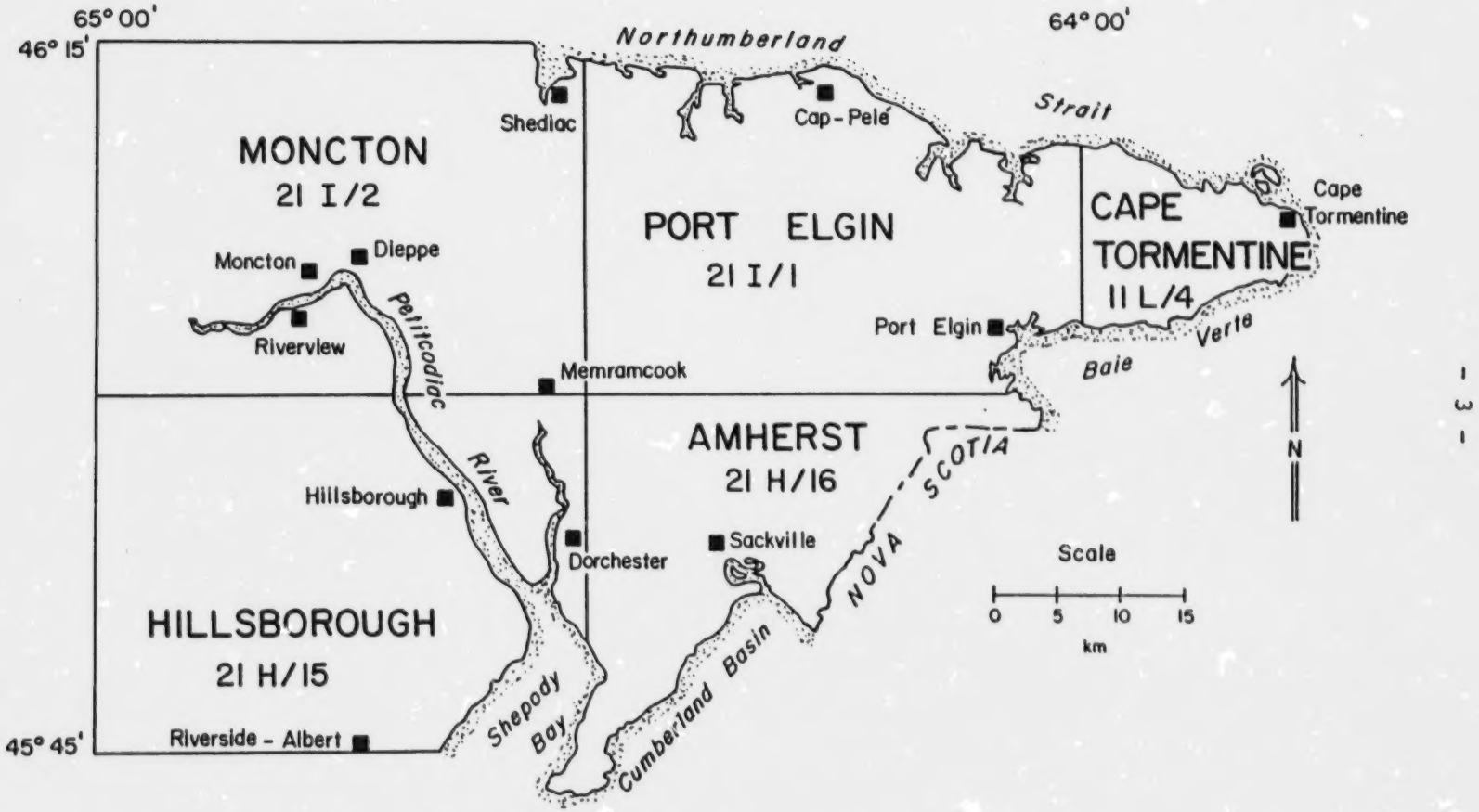

Figure 2. NTS 1:50 000 map sheets covering the study area

addition, the surficial geology of the village of Dorchester has been mapped in detail (Ruitenberg and Thibault 1980), and hammer seismic surveys to determine drift thickness have been carried out in the Moncton map area (Hobson and Carr 1967) and over the Demoiselle delta in the Hillsborough map area (Chandra et al. 1975). Limited information pertaining to surficial geology is also provided by the soil survey report for the area (Aalund and Wicklund 1950). The results of these studies have been summarized by Rampton et al. (1984).

Kingston (1974) summarized information pertaining to aggregate deposits that are accessible to the Moncton market. Details of the economic value of the fine aggregate deposits within this area are presented by ADI Limited (1975). In addition, Hamilton and Carroll (1975), in their preliminary survey of the aggregate resources of the province, provided information on a limited number of aggregate extraction sites within the study area.

THE PRESENT STUDY

The objective of this study is to provide basic information pertaining to the location, extent, thickness, and quality characteristics of the granular aggregate deposits in southeastern New Brunswick. It is part of an on-going, province-wide inventory of granular aggregate resources.

In contrast to the detailed field studies of most previous years, the mapping for this study was conducted at the reconnaissance level. There were two reasons for this: firstly, the surficial and Quaternary geology maps of Lohse (1974a, b, c, d, e) and Rampton and Paradis (1981a, b) already identified the few major granular aggregate deposits in the area; and secondly, the aggregate in most of the area is known to be of generally poor quality.

Initial evaluation of the granular aggregate resource potential of deposits in parts of the study area was made by H. Lohse in the summer of 1974. His field notes were used to supplement the observations of the author, and are credited as such. Field work by the author was carried out during the summer of 1985. All driveable roads were surveyed, and all known accessible excavations not previously described by Lohse were examined and described. Active or otherwise significant excavations that were previously described by Lohse, were re-examined. Where warranted, the material was sampled for textural and lithologic analyses.

The Appendices contain detailed descriptions of representative sites in major or significant granular aggregate deposits. These descriptions are accompanied by sample analyses from these locations, available test data from the New Brunswick Department of Transportation (DOT), general comments

pertaining to the deposits as a whole, and estimates of the workable reserves. Following the detailed descriptions, supplementary observations pertaining to granular aggregate deposits of lesser significance and to important or significant bedrock quarries are presented.

ACKNOWLEDGEMENTS

Capable field assistance was provided by William T. Bourque. The report was typed by Diane Blair; the maps were drafted by Terry Leonard. The report and maps were edited by Shasta A. Abbott.

PHYSIOGRAPHY, GEOLOGY, AND DRAINAGE

PHYSIOGRAPHIC UNITS

The southeastern New Brunswick area includes part of two physiographic units; the New Brunswick Lowlands to the east, and the Caledonian Highlands to the west (Figure 3). The brief summaries that follow concerning these units and their subdivisions are based on the detailed comments of Rampton et al. (1984), except as otherwise noted.

New Brunswick Lowlands: The New Brunswick Lowlands unit consists of a broad, relatively smooth plateau surface (Bird 1972). Two subdivisions of these Lowlands are present in the study area: the Central Lowland, and the Tormentine Peninsula (Figure 3). The Central Lowland subdivision consists of a broad, flat surface that slopes gently toward the Northumberland Strait. It is an area of low relief, except immediately adjacent to its major streams that may be incised to depths of several tens of metres below the surrounding surface. The Tormentine Peninsula is a broad, flat ridge with gentle flanking slopes. Relief in this area is also low.

Caledonian Highlands: The Caledonian Highlands unit comprises a central plateau flanked by boundary areas that typically exhibit valley and ridge topography. Five

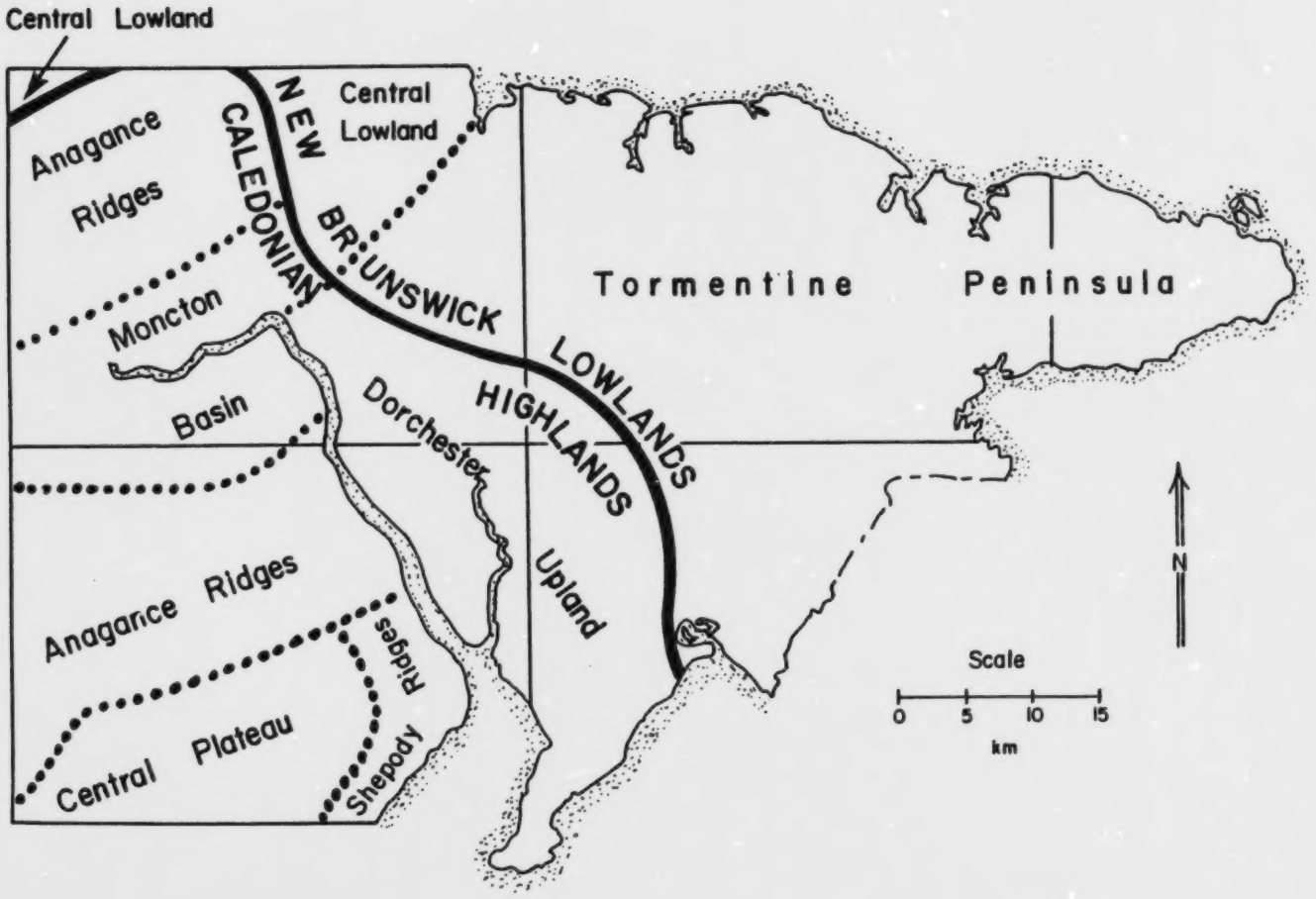

Figure 3. Physiographic units of southeastern New Brunswick (after Rampton et al. 1984)

subdivisons of these Highlands are present in the study area: the Central Plateau, the Anagance Ridges, the Moncton Basin, the Shepody Ridges, and the Dorchester Upland (Figure 3). The Central Plateau is an area of rolling topography characterized by the presence of rounded hills. Relief is generally in the order of 60 to 90 m, though adjacent to the coast, stream incision causes relief up to 270 m. The Anagance Ridges subdivision is the area of valley and ridge topography to the north and west of the Central Plateau. These valleys and ridges, parallel to the regional structural trend, are responsible for the high relief of the area. The Moncton Basin is an area of flat to gently rolling topography formed by the broadening of one of these structural valleys. The Shepody Ridges subdivision is another area of valley and ridge topography, in this case lying to the east of the Central Plateau. Relief is in the 60 to 150 m range. Finally, the Dorchester Upland subdivision is the area to the east of the Petitcodiac River and Shepody Bay, consisting of two broad, major ridges. The Upland surface ranges from relatively flat to the south through to ridged to the north.

BEDROCK GEOLOGY

Most of southeastern New Brunswick is underlain by sedimentary rocks of Carboniferous (Mississippian and Pennsylvanian) age (Figure 4). Sandstone is predominant, but

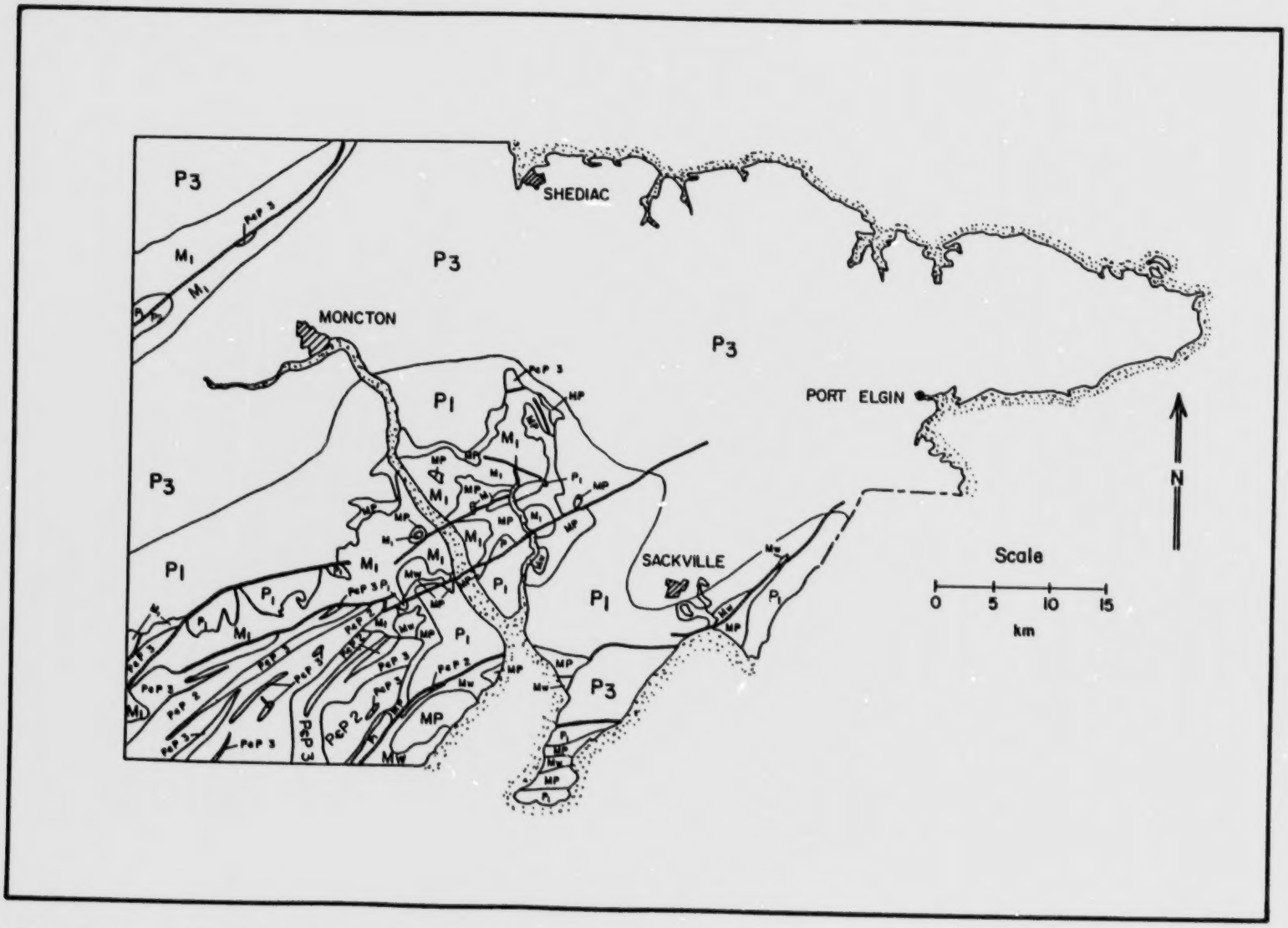

Figure 4. Bedrock geology of southeastern New Brunswick (from Potter et al. 1979; Ball et al. 1981)

BEDROCK GEOLOGY - LEGEND

PENNSYLVANIAN and/or PERMIAN

P_3	red to grey sandstone, shale, siltstone, and conglomerate; contains abundant plant fragments and scattered coal seams
P_1	white to grey quartzose sandstone and quartz pebble conglomerate

MISSISSIPPIAN and/or PENNSYLVANIAN

MP	red shale, siltstone, sandstone, and conglomerate

MISSISSIPPIAN

M_1	red to grey sandstone, conglomerate, and shale
Mw	limestone, gypsum, shale, and sandstone

PRECAMBRIAN or LOWER PALAEOZOIC

Pcp_3	granite, granodiorite, quartz diorite, and gabbro
Pcp_2	sedimentary, metasedimentary, volcanic, and metavolcanic rocks

significant areas of conglomerate, siltstone, and shale (including oil shale) are present, as are lesser areas of limestone and gypsum. These rocks are generally flat-lying under the New Brunswick Lowlands, except in areas adjacent to the Caledonian Highlands, where they are gently folded (Poole and Rodgers 1972). Within the Caledonian Highlands they are both folded and faulted (Ruitenberg and McCutcheon 1982).

The Central Plateau area in the southwestern corner of the study area, is underlain by deformed pre-Carboniferous (Precambrian or Lower Paleozoic) rocks (Ruitenberg et al. 1977). These comprise a diverse assemblage of igneous, sedimentary, and metamorphic rocks (Figure 4). Small, but economically significant, occurrences of granitic rocks of similar age are present to the north of Memramcook and northwest of Moncton.

Throughout much of the area, a weathered regolith is developed in the upper few metres of rock. This regolith is best developed in the Carboniferous clastic sedimentary rocks. It is probably of preglacial age (Chalmers 1895, 1989), though Rampton and Paradis (1981a) have suggested possible glacial or postglacial mechanisms as alternatives.

Further details concerning the geology of the different portions of southeastern New Brunswick can be obtained from Ball et al. (1981), Carr (1961), McLeod (1980), McLeod and Ruitenberg (1978), Norman (1941a, b), Ruitenberg et al. (1979), and Wright (1922).

SURFICIAL GEOLOGY

The predominant surficial unit in southeastern New Brunswick is a blanket of lodgment till of variable thickness. In the Moncton Basin, and over a significant portion of the Tormentine Peninsula, the till exceeds 1.5 m in thickness (Rampton and Paradis 1981a). In the latter area, the till surface is commonly drumlinized. Hobson and Carr (1967) report that the till thickness in the Moncton area ranges from less than 0.3 m to 48.8 m, with an average thickness of 5.5 m. In most of the Dorchester Uplands and Shepody Ridges areas, and in the higher portions of the Anagance Ridges, till thickness is less than 0.5 m. Elsewhere, it is generally between 0.5 and 1.5 m in thickness (Rampton and Paradis 1981a, b).

The texture of the till is largely dependent on the lithology of the local bedrock. Due to the predominance of sandstone and finer grained clastic sedimentary rocks in the area, most of the tills are silty sands or sandy silts. They are usually of reddish hue, due to the presence of redbeds in the sedimentary succession. In the vicinity of conglomerates, the tills are commonly pebbly. On the Precambrian rocks of the Central Plateau, the tills are characteristically stony.

Ablation moraines, composed primarily of ablation till, are present in several areas. The major one extends from the headwaters of the Memramcook River southward to the Sackville

area. It was probably formed along a suture between two remnant ice-caps (Rampton et al. 1984). The ablation moraines were found to be generally smaller than as mapped by Rampton and Paradis (1981a, b): no evidence was found to corroborate the presence of the "Tormentine moraine".

Glaciofluvial deposits are of minor extent in the area. They comprise small ice-contact systems, glaciofluvial outwash deposits, and outwash deltas, generally confined to valleys. An extensive, but thin, blanket of late-glacial marine sand is present along the shore of Northumberland Strait from Cap Pelé to Shediac. The marine submergence limit appears to vary from zero at Cape Tormentine to 30 m at Moncton, as proposed by Prest (1970), rather than the higher levels proposed by Rampton and Paradis (1981a, b).

The steeper slopes within the Caledonian Highlands are blanketed by colluvial deposits. Alluvium is present along the major stream valleys, while extensive tidal marshes flank the Petitcodiac, Memramcook, Tantramar, and Aulac rivers (Rampton and Paradis 1981a, b).

DRAINAGE

Approximately two-thirds of the southeastern New Brunswick area drains into the waters of the Bay of Fundy (Shepody Bay and Cumberland Basin), primarily via the Petitcodiac River and

its tributaries. The remainder of the area, comprising the northern portion of the Moncton map area, the northern and eastern three-quarters of the Port Elgin map area, and the Cape Tormentine map area, drain into the Gulf of St. Lawrence (Northumberland Strait and Baie Verte).

Drainage is generally good in the Caledonian Highlands (Rampton and Paradis 1981b; Rampton et al. 1984). Exceptions are in the Moncton Basin and the southern portion of the Dorchester Uplands, where it is generally poor (Rampton and Paradis 1981a; Rampton et al. 1984). Drainage in the New Brunswick Lowlands area is moderate to fair (Rampton and Paradis 1981a). Drainage patterns are variable. A typical trellis pattern is developed in the valley and ridge areas, and a dendritic pattern in the upland and plateau area; elsewhere, the pattern is generally irregular due to the effects of glacial derangement (Rampton and Paradis 1981a, b; Rampton et al. 1984).

GRANULAR AGGREGATE RESOURCES

QUALITY ANALYSIS

The quality of an aggregate material is dependent upon two primary physical characteristics:

1) the grain size characteristics of the material, and

2) the lithologies of its component clasts.

Grain Size Characteristics: The grain size characteristics of an aggregate are determined by passing a sample of the material through a nest of sieves (A.S.T.M. C136-76) and they apply specifically to the sample examined. Analysis of the collected samples was carried out by the N.B. Department of Transportation (DOT), using wet sieve analysis (A.S.T.M. C117-76) to accurately determine the silt/clay contents. The results of these mechanical analyses are tabulated in the Appendices.

The grain size characteristics of the material were also estimated in the field, on a qualitative basis, using the standard geological grain size classification outlined in Table I. The relative proportions of the major grain size clasts within the materials are described in terms of the textural classification outlined in Table II. In addition, the terms "fine aggregate" and "coarse aggregate" are used, to identify material predominantly finer and predominantly coarser, respectively, than 4.75 mm (A.S.T.M. C125-76).

TABLE I

GRAIN SIZE CLASSIFICATION
(Classification modified after Friedman and Sanders 1978)

Descriptive Size Category	Limiting Size (Minimum)	Approximate Equivalent In DOT Sieve Sizes (Not Passing)
Boulders	256 mm	-
Cobbles		
- large	128 mm	-
- small	64 mm	75 mm
Gravel		
- very coarse	32 mm	31.5 mm
- coarse	16 mm	19.0 mm
- medium	8 mm	9.5 mm
- fine	4 mm	4.75 mm
- very fine	2 mm	2.36 mm
Sand		
- very coarse	1 mm	1.18 mm
- coarse	500 um	600 um
- medium	250 um	300 um
- fine	125 um	150 um
- very fine	63 um	75 um
Silt and Clay (fines)	-	-

TABLE II

TEXTURAL CLASSIFICATION
(Modified from Folk 1968)

	% Passing 2.35 mm (Approximate Range)
Gravel	0 - 20
Sandy Gravel	20 - 70
Gravelly Sand	70 - 95
Sand	95 - 100

	% Passing 75 um (Approximate)
Silty	10
Slightly Silty	5 - 10

Lithologic Characteristics: The composition of the clasts within an aggregate deposit has a significant effect on the quality of the material. Preferably, clasts should exhibit three primary characteristics: a) they should be of good physical quality, b) they should be uncoated, and c) they should not react with any cementing materials.

To determine the lithologic characteristics of a deposit, a sample of approximately 100 pebbles in the 25 to 50 mm size range was collected from a fresh exposure. The lithologies represented by the clasts were determined, and they were divided into two groups, sound and unsound. The two groups are differentiated primarily on the basis of the resistance of the clasts to disintegration under mechanical impact (with the exception of chert, which exhibits chemical instability in concrete). The results of this test should not be confused with those from quantitative soundness tests (e.g., the sodium or magnesium sulphate tests), or those from abrasion tests (e.g., the Los Angeles abrasion loss test used by the N.B. Department of Transportation).

The results of the above qualitative soundness tests, plus any quantitative test results available from DOT, are tabulated in the Appendices.

QUALITY LIMITATIONS

There are five major factors which serve to degrade the quality of an aggregate: two relate to texture, and three to clast lithology. These are: 1) an excessive fine particle content; 2) poor grading; 3) poor physical quality of clasts; 4) coatings on clasts; and 5) reactive character of clasts (i.e., alkali-reactivity in cement).

Fine Particle Content: A content of fine particulate matter (that material passing through a 75 um sieve) in excess of five per cent in an aggregate is generally considered deleterious, and for some usages, even lower percentages are specified (Bates 1969).

Fine particles may occur as discrete beds within a deposit, as coatings on larger clasts, as disseminated particles throughout a deposit, or as some combination of the above. If an aggregate contains fines in excess of the specified limits for a particular use, it may be upgraded to an acceptable level by washing, with an attendant significant increase in the cost of exploitation. However, in the first case above, this may be avoided by selective extraction of material.

Grading: Grading refers to the particle size distribution within the aggregate (i.e., the relative proportions of material in the different size categories). The natural

grading of a deposit may be improved by crushing, by selective screening and recombination, or by the combination of materials from different sources or areas. However, such processing increases production costs. Excessive variability in the grading of a deposit can also lead to production problems.

Grading limits are specified by users (e.g., DOT), and will vary, depending upon the use of material. Poor grading may restrict the potential of some deposits for certain uses.

Physical Quality: Ideally, clasts should be hard, strong, and durable. Soft materials such as shale, schist, and friable sandstones are unsuitable for use in most aggregates, since they disintegrate easily, while porous or fractured rock fragments may split due to the expansion of water as it freezes (Bates 1969).

Poor physical quality is a significant quality-limiting factor of two-thirds of the coarse aggregate deposits in the study area, since most of the clasts in these deposits consist of the soft and highly porous Carboniferous sedimentary rocks.

Clast Coatings: The presence of silt, clay, carbonate, or oxide coatings on clasts renders them unsuitable for use in high-specification aggregate, since they weaken the bond between the clast and the cementing agent, and in concrete may

become chemically unstable (Bates 1969). Silt and clay coatings may be removed by washing, with a consequent increase in the cost of exploitation. Coatings of this type are prevalent on clasts in deposits with high fine particle contents, but may also be found in other deposits.

Alkali-reactivity: Clasts that consist of opaline or cryptocrystalline silica react with the alkalies in cement. As a result of this reaction, the clasts expand, producing cracks within the concrete making it susceptible to freeze-thaw and other destructive processes. The primary offenders are chert and some felsic extrusives (Bates 1969), though schists, quartzites, greywackes, argillites, and phyllites have also been shown to cause problems (Swenson 1973). In cases of suspected reactivity, the use of low-alkali portland cement or partial substitution of a pozzolanic material - such as fly-ash or finely ground siliceous material - for some of the cement is recommended (Bates 1969; Swenson 1973).

Chert does not appear to be overly abundant in the study area. However, the content of other potentially reactive clasts, particularly felsic extrusives, is high in those deposits of good physical quality (all in the Hillsborough map area). Considering the above recommendations, the materials from these deposits should be assumed to be reactive, until proven otherwise.

DESCRIPTION OF MAP UNITS

The major granular aggregate resources of the study area are found in deposits of five basic types. These are: 1) ablation till; 2) ice-contact stratified drift; 3) glaciofluvial outwash, including deltas; 4) shallow-water marine deposits; and 5) alluvium. A general description of each of these deposit types is presented below.

Albation Till: Ablation till comprises the material that was carried into the terminal zone of a melting glacier by transport within or upon the ice, and then deposited onto the ground by means of sliding, flowing, or subsidence (Flint 1971). "The resulting till is therefore loose, noncompact, and nonfissile, and its clasts are less strongly abraded than those in lodgment till" (Flint 1971; p. 171). Ablation till deposits may take on a variety of topographic forms, with surfaces ranging from flat through hummocky to ridged. Such deposits may range in size from small, isolated occurrences surrounded by lodgment till or bedrock, to extensive areas covering many square kilometres.

Typically, ablation till exhibits very poor sorting, generally containing the entire grain size range from clay through to boulders. Excessive quantities of both boulders, and silt and clay are present in many of these tills. Within the study area, these deposits are of very poor physical quality.

Ablation till deposits have only been mapped if they are of significant size and exhibit significant relief. The deposits mapped may contain smaller areas of bedrock, lodgment till, bogs, or other deposit types. Due to the very poor quality of their materials, the ablation till deposits of the area are not considered to be significant aggregate resources. However, they do have value as local sources of fill.

Ice-Contact Stratified Drift: Ice-contact stratified drift deposits are those deposits of glaciofluvial origin that are formed of sediment deposited by meltwater on or against glacial ice. Characteristically, such deposits form distinctive constructional landforms of various types. Within the study area these include eskers, kames and crevasse fillings, plus a few features of indeterminate, but presumed ice-contact, origin.

Eskers are linear accumulations of sediment formed either by deposition from meltwater streams flowing in tunnels within a melting glacier (Flint 1971), or by deposition of a series of overlapping fans or "beads" at the point of stream discharge from a retreating glacier (Embleton and King 1975). Kames are mound-like hills, ranging from conical to irregular, formed from sediment that was washed into crevasses or other openings or depressions in the glacier surface and remained as mounds after the ice melted away; crevasse fillings are features of similar origin that occur as short ridges (Flint 1971).

In general, ice-contact stratified drift deposits consist primarily of sand and gravel, with variable quantities of clay, silt, cobbles, and boulders. The sorting can vary from very poor to good, while the texture commonly exhibits abrupt lateral and vertical variations. Such deposits, due to their deposition in contact with glacial ice, commonly display postdepositional deformation structures as a result of slumping subsequent to ice withdrawal. Because of their close association with the glacier, pockets of ablation or lodgment till may be present.

Glaciofluvial Outwash: Glaciofluvial outwash comprises the sediment that is deposited beyond the margins of a glacier by the action of meltwater streams. In general, this material consists of well-washed, horizontally stratified sand or gravel. Glaciofluvial outwash deposits usually exhibit a flat, gently sloping topography. However, the meltwater streams that form these deposits may transport and deposit blocks of ice in addition to their regular sediment load. The melting-out of buried ice blocks within the outwash deposits results in the formation of small circular to irregular depressions in their surfaces referred to as kettle holes (Flint 1971).

Where meltwater streams discharge into bodies of standing water, outwash deltas are formed. These deposits consist of a topset unit of glaciofluvial outwash, typically one to several

metres thick, overlying steeply dipping foreset beds. The foreset beds are usually finer grained than the topset beds, and often consist primarily of fine aggregate, sometimes silty.

Shallow-Water Marine Deposits: Shallow-water marine deposits were generated by the action of waves in coastal areas during the interval of late-glacial submergence. These deposits typically occur as thin blankets of sand, gravelly sand, or sometimes sandy gravel, rarely exceeding 1 to 2 m in thickness and commonly overlying a till or weathered bedrock surface. One deposit of this type, between Dover and Upper Dover on the east side of the Petitcodiac River (Moncton map area), is overlain by till, probably deposited by a minor glacial readvance.

A number of small pockets of sand of shallow-water marine origin were mapped in the Moncton area by Lohse (1974d, e). Many of these appear to lie above the marine limit in the area, and may be of lacustrine or glaciofluvial origin. These deposits are not indicated on the accompanying maps since, due to their small size and shallow depths, they have no significant potential as workable aggregate resources. Other areas mapped by Lohse in which the marine sand blanket appears to be irregular and very thin have also been deleted from the maps.

Alluvium, Ancient and Modern: Alluvium consists of unconsolidated material that was deposited by the flowing water of streams or rivers during the postglacial period. Characteristically, the material consists of horizontally stratified sand or gravel, although it may also contain a significant silt component (usually in the form of discrete beds, commonly at the surface of the deposit). Within the study area, most of these deposits have very shallow water tables. Only in those instances where there appears to be a reasonable thickness of workable material are these deposits mapped.

GRANULAR AGGREGATE SOURCES

Cape Tormentine (11 L/4): The Cape Tormentine map area (Plate 86-217; Appendix A) is devoid of granular aggregate materials. The area is one of fine-grained lodgment till, locally exceeding 4 m in thickness, blanketing sandstone bedrock.

Hillsborough (21 H/15): The Hillsborough map area (Plate 86-218; Appendix B) is the only one in the study area containing significant sources of fair to good quality granular aggregate materials. These reserves are located in glaciofluvial outwash and delta deposits in the south-central portion

of the map area (H15-5, 6, 7, 9) and in an ice-contact deposit in the southwestern corner (H15-1). Workable reserves are estimated at approximately 1.9 million m^3.

Limited quantities of generally very poor to poor quality material are present in a number of small deposits scattered throughout the remainder of the map area.

Amherst (21 H/16): The Amherst map area (Plate 86-219; Appendix C) contains no known sources of quality granular aggregate material. Scattered ice-contact deposits contain small quantities of material. Extensive reserves of material are present in the ablation moraine that extends northward from the Sackville area (H16-2). Unfortunately, these materials are all of very poor quality. They are excessively silty, and their component clasts consist of soft, friable sandstone.

Port Elgin (21 I/1): The Port Elgin map area (Plate 86-220; Appendix D) also has a dearth of quality granular aggregate materials. Shallow-water marine deposits veneer an extensive area along the Northumberland Strait coast (I1-1, 2, 101). Where coarse aggregate is present in these deposits, the clasts consist almost ubiquitously of soft, friable sandstone, and therefore the material is of very poor quality. On the other hand, the fine aggregate makes a useable product when blended

with quality coarse material (ADI Limited 1975). However, these depostis are of irregular thickness, and only locally are workable thicknesses present. In addition, residential and recreational developments severely restrict exploitation of the resource (ADI Limited 1975). Consequently, these deposits have only a limited aggregate production potential.

The only other source of granular aggregate material in this map area is the ablation moraine near the headwaters of the Memramcook River (I1-103). As with the material in the portion of the deposit in the Amherst map area, the quality is very poor.

Moncton (21 I/2): The Moncton map area (Plate 86-221; Appendix E) is also characterized by a scarcity of granular aggregate material. Only one major deposit is present, located at Boundary Creek (I2-1), and its workable reserves are largely depleted (ADI Limited 1975; Kingston 1974). Minimal amounts of material, generally of very poor to poor physical quality, are present in scattered ice-contact and glaciofluvial outwash deposits. The shallow-water marine deposits in the Shediac area are sterilized by urban development, while similar deposits along the Petitcodiac River are of limited extent or subject to physical and quality constraints. The material present in the areas of ablation till is of typical very poor quality.

OTHER SOURCES OF AGGREGATE

Due to the paucity of granular aggregate material throughout most of the study area, extensive use has been made of bedrock as an aggregate. Quarries have been developed to produce materials ranging from fill through to concrete aggregate.

Low Specification Material: The weathered and shattered sandstones widespread throughout the area have seen extensive use as sources of borrow material. Sound sandstone has also been used in some areas. This material is of very poor physical quality. DOT test results for a number of sites (see: L4-101, 102, I1-104; I2-114, 116) indicate that the sandstone has Los Angeles abrasion losses ranging from 57.5 to 99.6%, with most exceeding 80%. These materials also exhibit very high to complete soundness losses (see: H16-111). However, sound sandstone beds do have potential for the production of building stone, and have been used successfully for this purpose in the past (Parks 1914).

Weathered conglomerates (and pebbly sandstones) have also seen extensive use as aggregate. In comparison to the sandstones, the conglomerates are of superior quality. DOT tests (H15-104, 115; I2-103) indicate Los Angeles abrasion losses of 27.4 to 42.8%. These materials, in the pit-run state, may be suitable for subbase usage. With processing to remove the

matrix material, these conglomerates could probably be used to produce even higher specification aggregate, since the component clasts consist predominantly of hard felsic extrusives, quartz and quartzite. However, the high potential for alkali-reactivity would probably render them unsuitable for use in concrete aggregate.

Where thick, lodgment till has been used as borrow material. This material has a very high fines content (I2-111), and is of very poor quality.

High Specification Material: High specification aggregate is produced by the crushing of Precambrian granitic rocks and associated metasedimentary rocks at sites northwest of Moncton (I2-104, 105) and north of Gaytons (I2-118). These sites produce high specification materials for use throughout most of southeastern New Brunswick.

Similar rock types are present in the southwestern quarter of the Hillsborough map area. Use of these rocks for aggregate has been minimal in this area, partly due to the wilderness character of much of the area, and partly due to the availability of good quality granular material in the vicinity. However, the area has future potential as a source of high specification aggregate.

CONCLUSIONS

The southeastern New Brunswick area is characterized by a severe shortage of quality granular aggregate materials. Total known workable reserves of fair to good quality material in the five map areas is estimated to be less than 2 million m^3. All of this material is located in five deposits in the southern half of the Hillsborough map area. Extensive quantities of very poor quality material are present in the large ablation moraine lying between the headwaters of the Memramcook River and the Town of Sackville, and in smaller moraines scattered through the Moncton and Hillsborough map areas. Due to its quality, this material does not constitute a significant aggregate resource.

Weathered and unweathered sandstones and conglomerates have seen extensive use as low to moderate specification aggregate. For high specification material, it has been necessary to resort to crushing Precambrian granitic rocks and associated metasediments.

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APPENDIX A

SITE DESCRIPTIONS

CAPE TORMENTINE MAP AREA

11 L/4

L4-101 UTM 248 038

This large, abandoned quarry is developed in sandstone. It is approximately 3 to 6 m deep, with less than 1 m of till at the surface. Two samples of sandstone from this site were tested by DOT (1959). They had extreme Los Angeles abrasion losses of 98.5% and 98.8%.

Samples of sandstone obtained from two other sites in this general area had Los Angeles Abrasion losses ranging between 93.0% and 98.2% (DOT 1959, 1975).

L4-102 UTM 319 115

This is another quarry exposing thin till overlying soft sandstone. Los Angeles abrasion losses for two samples were 99.3% and 99.5% (DOT 1959). A sample from an area to the east of Peacock Cove gave a similar Los Angeles abrasion loss of 99.2% (DOT 1959).

L4-103 UTM 347 081

This large, abandoned quarry, approximately 6 m deep, also exposes thin till overlying soft sandstone. This material was used to construct the embankment for the proposed causeway to Prince Edward Island, which now extends from Highway 16 to the northeastern edge of Jourimain Island.

Immediately to the west of the quarry, a cleared rock surface exhibits three main cross-cutting sets of striations. The ice-flow azimuths for these striae are: 213° (first); 189° (second); and 327° (last). Evidence for a minor variation of the latter flow (309°) is also present. The northwestward flow is dominant at this site, and is confirmed by nail-head striations. An outcrop to the south of Highway 16 has small-scale crag-and-tail features that indicate a similar ice-flow direction. The southerly and southwesterly azimuths were not determined at this site, but were deduced from observed definitive ice-flow indicators elsewhere in the area.

APPENDIX B

SITE DESCRIPTIONS

HILLSBOROUGH MAP AREA

21 H/15

LOCATION NO.:	H15-1	NTS:	21 H/15
TYPE OF DEPOSIT:	Ice-contact	COUNTY:	Albert
EXPOSURE TYPE:	Road cut	PARISH:	Elgin
STATUS:	Undeveloped	UTM:	464 733

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Slightly silty; developed on the underlying material.

1.3 m Cobbly Gravel: Poorly sorted, cobbly medium to very coarse gravel, with a matrix of gravelly medium to very coarse sand; clasts are subangular to rounded; maximum clast size is 0.3 m.

2.0 m Slump Covered: Assumed to be material as above.

This section is in a broad ridge, possibly an esker, with a maximum height of approximately 5 m. The material in the western portion of the deposit appears to be generally finer, predominantly sandy gravel.

MECHANICAL ANALYSIS (% passing):

sieve	50 mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	72.0	50.0	46.5	35.8	28.5	21.2	14.0	6.8	3.7	2.5	1.9

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 16%	Sound Lithotypes 84%
felsic intrusive 11; metasedimentary 3; sandstone 1; schist 1	felsic intrusive 33; gneiss 16; mafic intrusive 12; mafic extrusive 9; metasedimentary 8; felsic extrusive 3; sandstone 1; greywacke 1; quartzite 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
18	10	1.5	150,000

LOCATION NO.:	H15-2	NTS:	21 H/15
TYPE OF DEPOSIT:	Ice-contact	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hillsborough
STATUS:	Abandoned	UTM:	541 871

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Developed in a sandy gravel (mainly sandstone clasts) and in the upper part of the underlying material.

1.3 m Sand: Well-sorted, cross-bedded medium sand, with a very thin gravel bed near the base.

2.8 m Slump Covered: Assumed to be sand; the base of the pit lies at the water table.

The above section is in a broad ridge, possibly an esker. Maximum clast size in the pit area is 0.5 m. The workable reserves remaining are limited.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.					100.0	99.5	87.1	31.4	6.3	2.3

LITHOLOGIC ANALYSIS: N/A

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable / Limited

LOCATION NO.:	H15-3	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hillsborough
STATUS:	Active on demand (lightly)	UTM:	652 836

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Slightly silty; developed on the underlying material.

1.0 m Sandy Gravel: Indurated, partially iron-cemented, fine to coarse gravel and medium to coarse sand; subhorizontally stratified; clasts are subrounded to rounded; maximum clast size is 0.3 m.

0.3 m Sand: Gritty medium sand.

The material in the above section was difficult to dig. The sample for analysis was taken from a tiny stockpile. The reserves of the deposit are limited, due to its small size and the presence of sterilizing cultural features.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	85.5	79.6	59.9	43.1	30.6	22.6	13.8	6.1	2.4	1.3

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 47%	Sound Lithotypes 53%
sandstone 26; felsic extrusive 6; conglomerate 4; felsic intrusive 3; metavolcanic 3; metasedimentary 2; weathered 2; siltstone 1	sandstone 18; felsic extrusive 12; metavolcanic 11; felsic intrusive 6; metasedimentary 5; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited

LOCATION NO.:	H15-4	NTS:	21 H/15
TYPE OF DEPOSIT:	Ice-contact (esker)	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hopewell
STATUS:	Inactive	UTM:	636 762

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Slightly silty; developed on the underlying material.

1.3 m Cobbly Gravel: Poorly sorted, cobbly very fine to very coarse gravel, with medium to very coarse sand; contains a few openwork gravel beds; exhibits crude subhorizontal stratification; clasts are subrounded; maximum clast size is 0.5 m.

2.3 m Slump Covered: Assumed to be gravel as above.

This tiny esker is not visible on the aerial photographs. As a consequence, it could be longer than as mapped. Additional, currently unknown, deposits of similar character could be present in the area, providing material of local usefulness.

MECHANICAL ANALYSIS (% passing):

sieve	50 mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	70.9	50.6	42.8	31.7	23.5	14.5	8.2	2.5	0.7	0.4	0.3

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 12%	Sound Lithotypes 88%
felsic intrusive 7; mafic extrusive 2; metasedimentary 2; sandstone 1	felsic intrusive 21; mafic intrusive 16; mafic extrusive 16; gneiss 11; felsic extrusive 10; metasedimentary 6; metavolcanic 5; sandstone 2; greywacke 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable	Minimal

LOCATION NO.:	H15-5	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hopewell
STATUS:	Inactive	UTM:	639 699

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Slightly silty; developed on the underlying material.

1.5 m Cobbly Sandy Gravel: Poorly sorted, cobbly sandy very fine to very coarse gravel, with a few boulders; the sand component is variable, in different beds, ranging from slightly silty very fine to medium through to medium to very coarse (the latter being dominant); the unit exhibits crude horizontal stratification; clasts are subrounded; maximum clast size is 0.8 m.

2.2 m Slump Covered: Assumed to be gravel as above.

The material in this outwash deposit and in the one to the north appears to be a good quality sandy gravel. Reserves are calculated for the lower terrace and the northern deposit, combined. The extent of the upper terrace requires confirmation; it may be limited. Reserves could be increased if the road was moved to allow excavation of its present bed.

MECHANICAL ANALYSIS (% passing):

sieve	50 mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	74.7	62.8	55.9	42.9	33.8	24.7	18.7	12.6	7.8	4.2	2.6

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 10%	Sound Lithotypes 90%
schist 5; mafic extrusive 2; sandstone 2; felsic intrusive 1	felsic intrusive 33; mafic extrusive 18; felsic extrusive 15; gneiss 8; metasediments 6; mafic intrusive 5; quartz 3; greywacke 1; quartzite 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
37	10	2	200,000

LOCATION NO.:	H15-6	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash (delta)	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hopewell
STATUS:	Abandoned	UTM:	686 691

SECTION DESCRIPTION & COMMENTS:

0.7 m Soil: Silty; developed on the underlying material.

1.4 m Sandy Gravel: Subhorizontally stratified, very fine to medium gravel and medium to very coarse sand; clasts are subrounded; maximum clast size is 0.3 m; Sample A was obtained from this unit.

3.5 m Sand: Interbedded sandy silt, clean fine sand, and gravelly medium to coarse sand; the beds dip gently southward (at approximately 5 to 10°); clean fine sand beds are dominant; gravelly sand beds are present primarily in the upper third of the unit; Sample B was obtained from the basal 0.6 m of the unit.

1.0 m Slump Covered: Assumed to be sand as above.

Material similar to that described above is present in the larger delta segment to the west of the creek. The remaining reserves of significance are in the latter area.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass. A	94.4	91.6	77.6	62.6	46.5	31.7	14.6	3.3	0.4	0.1
(partial)				100.0	74.3	50.6	23.3	5.3	0.6	0.2
B							100.0	94.4	45.4	15.0

LITHOLOGIC ANALYSIS: +12.7 mm fraction

Unsound Lithotypes 29%	Sound Lithotypes 71%
sandstone 16; felsic intrusive 3; siltstone 3; metasedimentary 2; mafic extrusive 1; conglomerate 1; chert 1; schist 1; slate 1	felsic intrusive 17; felsic extrusive 16; mafic extrusive 12; metasedimentary 9; gneiss 5; quartz 4; mafic intrusive 3; metavolcanic 2; sandstone 1; siltstone 1; quartzite 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
30	5	3	150,000

LOCATION NO.:	H15-7	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash	COUNTY:	Albert
EXPOSURE TYPE:	Road cut	PARISH:	Hillsborough
STATUS:	Undeveloped	UTM:	692 795

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Slightly silty; developed on the underlying material.

0.2 - 0.8 m Sandy Gravel: Very fine to coarse gravel and fine to very coarse sand, with a few cobbles; clasts are subrounded; maximum clast size is 0.2 m.

0.5 - 1.1 m Sand: Slightly gravelly medium to coarse sand.

0.2 m Silty Gravelly Sand: Silty very fine to fine sand with predominantly coarse to very coarse gravel clasts.

The sample is a composite of 2 sections from the middle 2 units. The material in the western part of the deposit appears to be generally coarser.

This deposit gives the appearance of being a kettled outwash. However, due to the presence of numerous sinkholes in the gypsum deposits in this area, the "kettles" may be due to sediment collapse into sinkholes.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	92.4	88.3	74.0	62.6	52.9	45.3	29.5	9.3	2.8	1.7
(partial)				100.0	84.5	72.4	47.1	14.9	4.5	2.7

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 55%	Sound Lithotypes 45%
sandstone 47; schist 3; metasedimentary 2; felsic intrusive 1; metavolcanic 1; slate 1	sandstone 11; metasedimentary 7; felsic extrusive 6; quartzite 6; mafic extrusive 5; felsic intrusive 4; metavolcanic 3; gneiss 2; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
35	20	2	400,000

LOCATION NO.:	H15-8	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash (delta)	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hopewell
STATUS:	Abandoned	UTM:	729 774

SECTION DESCRIPTION & COMMENTS:

SECTION A

0.6 m Soil: Slightly silty; developed on the underlying material.

0.9 m Sandy Gravel: Poorly sorted, cobbly very fine to very coarse gravel and medium to very coarse sand, with a few boulders; clasts are subrounded to rounded; maximum clast size is 0.4 m; Sample A was obtained from this unit.

0.2 m Sand and Silt: Interbedded, reddish sandy silt and silty very fine to fine sand; contains a few scattered pebbles and cobbles.

3.2 m Slump Covered: Assumed to be sand or gravel; bedrock is exposed at the base of the pit.

SECTION B

4 m Sand and Gravelly Sand: Interbedded sand and gravelly sand; the sand units vary from very fine to fine through to coarse to very coarse; the gravelly sand units are generally medium to coarse sand with very fine to medium gravel; Sample B was obtained from the lower 1.5 m of this section.

Workable reserves in this deposit are minimal, due to residential and associated development. A meeting hall is now located in the northern portion of the pit area, adjacent to Section B.

MECHANICAL ANALYSIS (% passing):

sieve	50 mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% A	72.9	63.5	60.4	47.3	37.4	27.7	20.6	12.1	5.0	2.3	1.5
pass.											
B			100.0	92.8	85.3	73.2	55.2	29.5	9.4	3.7	2.2
(partial)					100.0	85.8	64.7	34.6	11.0	4.3	2.6

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 78%	Sound Lithotypes 22%
sandstone 74; conglomerate 1; siltstone 1; felsic intrusive 1; metasedimentary 1	sandstone 7; felsic extrusive 3; quartzite 3; felsic intrusive 2; mafic intrusive 2; mafic extrusive 2; gneiss 2; metavolcanic 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Minimal

LOCATION NO.:	H15-9	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash (delta)	COUNTY:	Albert
EXPOSURE TYPE:	Pit	PARISH:	Hopewell
STATUS:	Abandoned	UTM:	747 742

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Slightly silty; developed on the underlying material.

0.8 m Gravelly Sand: Subhorizontally stratified, medium to coarse sand with very fine to medium gravel; a few thin (several cm thick) gravel beds are present; clasts are subrounded to rounded.

0.6 m Slump Covered: Assumed to be material as above; the base of the pit is wet.

The largest clast in the pit area is an erratic 0.5 m in size. This is an extreme, however, as there are almost no other clasts larger than 10 cm in size. Kingston (1974) reported the following analysis for a sample from this area: 80% passing 4.75 mm, 1.1% passing 75 um, Los Angeles abrasion loss 26.6%. The material in this deposit may have significant organic contamination (ADI Limited 1975).

This deposit is a large outwash delta at the mouth of Demoiselle Creek. Seismic data (Chandra et al. 1975) and observations suggest that the deposit is thickest in its eastern portion (see: H15-114). The seismic profiles suggest thicknesses of 2.2 to 6.9 m in this western portion of the deposit (with one exception, 15.1 m in the extreme eastern part). To the south of the deposit, clay, till, or a thin veneer of sandy gravel over till were observed.

(CONTINUED)

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	100.0	94.4	85.0	71.7	59.9	47.8	28.8	8.3	2.5	1.5
(partial)				100.0	83.5	66.7	40.2	11.6	3.5	2.1

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 66%	Sound Lithotypes 34%
sandstone 56; felsic intrusive 4; siltstone 2; shale 2; chert 2	felsic extrusive 10; sandstone 8; felsic intrusive 6; quartzite 4; greywacke 2; metasediments 2; quartz 2

ESTIMATION OF RESERVES:

	Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
H15-9	90	40	1.5	600,000
H15-114	30	8	5	400,000

LOCATION #: H15-9 (cont'd)

Workable reserves for this main, western portion of the delta were estimated at 760,000 m^3 by Kingston (1974). These reserves have been revised downward to 600,000 m^3. It should be noted that all of these reserves may not be recoverable, for other than physical reasons. There may be additional reserves in the possible deposit area to the west: these would require confirmation. The deposit area to the southwest contains no economically significant reserves due to its limited thickness (Kingston 1974).

LOCATION NO.:	H15-10	NTS:	21 H/15
TYPE OF DEPOSIT:	Glaciofluvial outwash	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Dorchester
STATUS:	Inactive	UTM:	751 898

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Slightly silty; developed on the underlying material.

2.3 m Gravelly Sand: Large- to small-scale trough cross-bedded fine to medium sand with very fine to coarse gravel and a few cobbles; a few beds of well-sorted fine to medium sand are present, primarily in the lower half of the unit; clasts are subrounded to rounded.

0.4 m Sand: Horizontally stratified fine to medium sand with silty bands.

Maximum clast size in the pit area is 0.4 m. Within 5 m of the above section, stratified clays occupy the lower half of the section. The clays are probably separated from the overlying material by an erosional unconformity.

Due to the small size of the deposit, its dissection by Belliveau Creek, and the variable depth to the underlying clays, reserves are considered to be limited.

MECHANICAL ANALYSIS (% passing):

sieve %	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
pass.	98.6	96.3	90.7	85.4	79.7	75.2	64.0	35.6	9.7	4.4
(partial)				100.0	93.3	88.1	74.9	41.7	11.4	5.2

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 95%	Sound Lithotypes 5%
sandstone 82; siltstone 13	felsic extrusive 2; mafic extrusive 1; quartzite 1; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited

LOCATION NO.:	H15-11	NTS:	21 H/15
TYPE OF DEPOSIT:	Marine shallow-water	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Dorchester
STATUS:	Active-on-demand	UTM:	817 914

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Slightly silty; developed on the underlying material.

1.0 m Sand: Clean fine to medium sand grading downwards into interbedded fine sand and sandy silt; the sand to silt ratio in the lower half of the unit is approximately 3-4:1.

0.4 m Slump Covered: Assumed to be sand as above; the base of the pit is wet.

Maximum clast size in the pit area is 0.1 m.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.					100.0	99.6	98.7	82.4	31.3	8.9

LITHOLOGIC ANALYSIS: N/A

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable	Limited

H15-101 UTM 460 816

This site is a small, long abandoned pit in the alluvium of the Little River. Lohse (field notes, 1974) indicates that it is 1.2 to 1.8 m deep, with a silty sand overburden ranging from 0.3 to 0.9 m in thickness. DOT (1958, 1973) data indicate an average workable depth of 2 m, with a maximum of approximately 3.5 m. The results of DOT (1958, 1973) tests are as follows:

Fine Aggregate (1 sample)
98.8% passing 4.75 mm
4.9% passing 75 um

Coarse Aggregate (13 samples)
29% to 59% passing 4.75 mm (average 40%)
0.2% to 7.1% passing 75 um (average 2.8%)
Los Angeles abrasion loss - 34.0% to 47.6% (average 40.3%).

The material was recommended for use as borrow and subbase aggregate.

Samples of similar material from two sites approximately 5 km further north along the Little River were also tested by DOT (1973). The following results were obtained (for 5 samples):

26% to 55% passing 4.75 mm (average 40%),
0.7% to 2.5% passing 75 um (average 1.3%),
Los Angeles abrasion loss - 36.2% (average).

These materials were also recommended for use as borrow and subbase aggregates.

The above deposits are all of limited extent. More extensive alluvial deposits to the south of Parkindale and at Prosser Brook are probably of similar character. However, the shallow depths to the water table, and the agricultural potential of these lands, limits their usefulness as sources of aggregate.

H15-102 UTM 447 755

This hillside borrow pit exposes approximately 10 to 20 m of sandy angular gravel of colluvial origin. Similar materials may be found along the steeper hillslopes elsewhere in the area. The quality of such material is typically poor, akin to ablation till. However, it is of local value as a source of borrow material.

H15-103 UTM 493 765

A small kame, approximately 9 m high, is present at this site. A 3 m deep trench through the deposit exposes subhorizontally stratified, gravelly fine to coarse sand. Most of the clasts consist of hard volcanic and metamorphic rock types. Reserves are minimal. Similar small deposits could be present elsewhere in the area, but are obscured from view by forest vegetation.

H15-104 UTM 510 781

This small, abandoned quarry exposes approximately 1 to 3 m of deeply weathered pebbly sandstone. The site was tested by DOT (1978), with the following results being obtained (from 5 samples):

68% to 82% passing 4.75 mm (average (74%),
7.6% to 18.0% passing 75 um (average 11.6%),
Los Angeles abrasion loss - 28.3% and 30.2%.

The material was recommended for borrow usage.

Similar materials are exposed in the two quarries approximately 1 and 1.5 km to the east.

H15-105 UTM 547 826

This shallow, long abandoned pit lies within the alluvium of the West Branch Turtle Creek. DOT (1961) indicates that the water table is shallow, lying at a maximum depth of approximately 1.5 m. The results of the DOT (1961) testing are as follows (for 4 samples):

31.8% to 48.0% passing 4.75 mm (average 42.0%),
1.0% to 3.2% passing 75 um (average 2.0%),
Los Angeles abrasion loss - 26.7%.

The material is good quality sandy gravel, which DOT (1961) recommended for use as borrow, subbase, and base course aggregate. Unfortunately, these alluvial deposits are of very narrow width, which, in conjunction with the shallow water table, severely limits the quantity of material available.

H15-106 UTM 621 931

This site is a small pit, active-on-demand, developed in a hummock of ablation till. The section exposes approximately 2 m of silty sandy angular gravel. DOT (1962) testing of similar materials in this neighbourhood provided the following results (for 3 samples):

28.7% to 60.0% passing 4.75 mm (average 40.7%),
1.1% to 13.7% passing 75 um (average 5.6%),
Los Angeles abrasion loss - 83.4%.

The material, described as a sandstone gravel, was recommended for use as borrow and as a possible soil-cement aggregate.

The deposit boundary indicated on the map is an attempt to outline the thickest area of ablation till. The actual area of ablation till is more extensive, particularly to the west, but relief appears lower while bogs are numerous.

The adjacent quarries expose thin till or ablation till overlying approximately 2 to 5 m of shattered sandstone.

H15-107 UTM 679 948

This site is an abandoned pit in the outwash delta at the mouth of Stoney Creek. Lohse (field notes, 1974) described this site as exposing 6 m of medium to coarse sand with minor gravel and a few silty fine sand beds, overlying 3 m of interbedded fine sand and reddish silty sand. Workable reserves were estimated at 380,000 m^3 (Kingston 1974). However, ADI Limited (1975) reported that present land uses "effectively prevent access to the remaining good material.".

H15-108 UTM 686 917

This site is one of several abandoned to active (on demand) quarries developed near the top of Oil Hill. These quarries typically expose less than 0.5 m of till overlying 2 to 5 m of weathered conglomerate with shattered sandstones. This conglomerate is similar in character to that found elsewhere in the region (see: H15-115; H16-101).

H15-109 UTM 684 889

A road cut at this site exposes approximately 1.5 m of sandy gravel. The sand is medium to coarse; the gravel consists almost totally of sandstone clasts.

The several small outwash deposits along Weldon Creek between Salem and Weldon contain similar materials, and also silty sands (Lohse, field notes, 1974). The poor material quality and small size of these deposits, combined with cultural development, severely limits the potential of these deposits as sources of aggregate materials.

H15-110 UTM 725 883

This site is an old pit, subsequently a dump, at the eastern end of the topographical feature called Grays Island. This feature, surrounded by tidal marsh deposits, was identified as outwash by Lohse (1974a), but appears more likely to be an ice-contact deposit, possibly a kame moraine or kame delta. Small exposures in the flanks of the deposit exhibit gravelly sand to sandy gravel, with a few cobbles. The surface of the deposit is occupied by a cemetery, which effectively sterilizes its aggregate resources.

H15-111 UTM 632 823

This abandoned, largely depleted pit exposes approximately 3 to 4 m of cobbly sandy gravel. Redbed conglomerates may be present at the base of the pit. The deposit appears to be an alluvial fan, of limited extent. Bedrock crops out along the road, immediately to the west of the small stream. Reserves are limited.

Lohse (1974b; field notes, 1974) noted a similar deposit approximately 1 km to the east. It appears to have limited areal extent. Tiny areas of outwash also appear to be locally present along Weldon Creek in this area.

Kingston (1974) estimated recoverable reserves for this upper portion of Weldon Creek at 150,000 m^3. However, ADI Limited (1975) did not consider these reserves to be economically recoverable.

H15-112 UTM 618 818

Approximately 1 to 3 m of gravelly sand is exposed in this small, abandoned pit. Silt is present at the base of the pit. Lohse (field notes, 1974) noted "haphazard, steeply dipping bedding," suggesting an ice-contact origin. The deposit is of limited extent, with weathered conglomerate being exposed in a road cut immediately adjacent to the pit. Reserves are minimal.

The material from this pit was tested by DOT (1978). The results were as follows (for 6 samples):

62% to 90% passing 4.75 mm (average 77%),
6.9% to 27.1% passing 75 um (average 17.5%),
Los Angeles abrasion loss - 43.7% and 46.5%.

The material was recommended for use as borrow and blending sand. The high Los Angeles abrasion loss is probably representative of other materials in the Weldon Creek valley (i.e., H15-3, -109, -111).

H15-113 UTM 640 676

Outwash sandy gravel, similar to that in the deposit to the north (H15-5), is exposed in this long abandoned pit. Lodgment till may be present at the base of the pit. The pit is in the proximal part of a delta: a typical delta sequence is present in the southern portion of the deposit (south of the map area boundary) (Thibault 1978).

Materials from this deposit have been tested by DOT (1973, 1974). They reported the following results (for 9 samples):

25% to 77% passing 4.75 mm (average 45%),
1.1% to 3.8% passing 75 um (average 1.8%),
Los Angeles abrasion loss - 19.4% to 21.6% (average 20.7%).

The coarser materials were recommended for use as borrow, subbase, and base course aggregate, while the finer materials were recommended for borrow and subbase usage and as possible sources of filter, blending, and winter sands.

Within the limits of the Hillsborough map area, the aggregate potential of this deposit is limited, due to the presence of the municipality of Riverside-Albert on its surface.

H15-114 **UTM 756 746**

This abandoned pit is in the eastern portion of the Demoiselle Delta. Lohse (field notes, 1974) described the exposed section as exhibiting 0.6 m of sandy gravel overlying 9 m of cross-bedded gravelly sand and silty sand, with the beds dipping approximately eastward. Analysis of a sample from this site (Kingston 1974) provided the following results:

81% passing 4.75 mm,
3.6% passing 75 um,
Los Angeles abrasion loss - 24.3%.

Six hammer seismic profiles indicate workable thicknesses of material between 3.4 m and 10.0 m (Chandra et al. 1975). Workable reserves were estimated as 840,000 m^3 for this portion of the delta (Kingston 1974). ADI Limited (1975) considered this estimate too high. Approximately 8 ha of this portion of the deposit appears to be free of physical constraints on development: using a conservation workable depth of 5 m, workable reserves are now estimated at 400,000 m^3.

H15-115 **UTM 766 901**

This active quarry exposed approximately 3 to 5 m of weathered conglomerate, overlain by less than 0.5 m of till. Two samples of material from this site were tested by DOT (1961). The results were as follows:

27.9% and 39.0% passing 4.75 mm,
3.9% and 4.7% passing 75 um,
Los Angeles abrasion loss - 42.8%.

The material was recommended for use as borrow and subbase aggregate. With processing to remove matrix materials, it might be possible to produce even better quality aggregate, since the clasts in these conglomerates are typically hard volcanics, quartzite, and quartz (see: H16-101).

H15-116 **UTM 775 843**

This old, largely overgrown sandstone quarry is greater than 10 m deep. The rock grades from weathered sandstone at the top through shattered sandstone to solid sandstone at the base. Immense quantities of building stone were removed from this site during the latter half of the nineteenth century (Parks 1914). Details concerning the quality of the building stone from this site and others in the area can be found in Parks (1914, pp. 50-60).

H15-117 UTM 807 914

This active (on demand) quarry, and the adjacent ones to the north and the south, expose approximately 2 to 4 m of weathered conglomerate overlying sandstone. The conglomerate is blanketed by till less than 1 m thick. The material is similar to that found in other conglomerate quarries in the area (i.e., H15-115, H16-101).

H15-118 UTM 829 829

This deposit may be a small outwash delta. A road cut at this site exposes poor quality sandy sandstone gravel. The aggregate resources in the deposit are effectively sterilized by the presence of a cemetery, and residential and commercial development.

APPENDIX C

SITE DESCRIPTIONS

AMHERST MAP AREA

21 H/16

LOCATION NO.:	H16-1	NTS:	21 H/16
TYPE OF DEPOSIT:	Ice-contact	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Westmorland
STATUS:	Abandoned	UTM:	108 925

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Silty and reddish brown; developed on the underlying material.

0.8 m Sand: Clean to silty fine sand with a few pebbles, cobbles and boulders; clasts are angular to rounded; maximum clast size is 0.5 m; the material is faintly stratified, and becomes denser with depth.

1.1 m Slump Covered: Assumed to be material as above.

The maximum exposure in this pit is approximately 6 m. Similar material is exposed in road cuts along Highway 16, though it is locally till-like in character. All of the clasts observed were sandstones, many of them striated.

The boundaries of this deposit are indistinct, and detailed exploration could prove more reserves. A similar deposit near Jolicure, also with indistinct boundaries has been tested by DOT (1964; see: H16-110).

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.			100.0	98.8	98.0	97.4	96.0	81.2	37.5	18.7

LITHOLOGIC ANALYSIS: N/A

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
25	10	2	200,000

LOCATION NO.:	H16-2	NTS:	21 H/16
TYPE OF DEPOSIT:	Ablation till	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Sackville
STATUS:	Active-on-demand	UTM:	923 853

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Silty; developed on the underlying material.

1.2 m Gravelly Sand: Slightly silty to very silty, very fine to medium sand, with numerous pebbles and a few cobbles and boulders; clasts are subangular to subrounded; many of the clasts are striated.

2.4 m Slump Covered: Assumed to be material as above.

Maximum clast size in the pit area is 0.8 m. Most of the cobbles and boulders are sandstones, but some granitic and metamorphic erratics are present. Many of the smaller clasts are weathered.

This site is representative of the materials in the ablation moraine that extends from Sackville north to the headwaters of the Memramcook River. The material appears to become less silty toward the north, and becomes brownish rather than reddish. However, the quality still remains very poor. It is only suitable for use as fill. Thus, while reserves are extensive, its aggregate potential is only limited.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	93.3	92.2	85.5	80.4	75.9	72.9	66.0	52.3	33.7	19.9

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 85%	Sound Lithotypes 15%
sandstone 80; siltstone 3; mafic extrusive 2	sandstone 12; quartzite 2; siltstone 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Extensive

H16-101 UTM 853 930

This quarry, approximately 2 m deep, exposes weathered conglomerate overlain by less than 0.5 m of till. Results of a pebble count of clasts in the conglomerate are as follows:

55% volcanic (predominantly rhyolite)
25% quartz
19% quartzite
1% sandstone.

H16-102 UTM 862 91 31

The exposure is a tiny pit in a small kame. Clean, well-sorted medium sand and silty sandy gravel are exposed. Reserves are minimal.

H16-103 UTM 855 93 14

This is another exposure in weathered conglomerate. A very thin soil overlies the conglomerate, which is being worked to a depth of 2 to 4 m. The material is crushed and screened on site. Boulder-size core-stones of unweathered conglomerate are locally present within the weathered material. The inactive quarry area immediately to the north exposes approximately 8 to 10 m of weathered conglomerate with interbedded sandstone.

H16-104 UTM 884 883

Approximately 2 m of sand and sandy gravel, with minor till, is exposed in this small pit developed in a small deposit of probable ice-contact origin. Wet sand is present to a depth of at least 1 m below the base of the pit. The gravel contains an anomalous abundance of good quality clasts, derived from the local conglomerate bedrock.

The adjacent quarry exposes 1 to 2 m of "conglomeratic" till overlying 2 to 3 m of weathered conglomerate.

H16-105 UTM 869 791

This site is a road cut in a small ice-contact deposit, possibly a tiny esker segment. Approximately 1 m of sandy sandstone gravel is exposed. The aggregate potential of this deposit is minimal.

H16-106 **UTM 929 834**

This site is an old building stone quarry, long abandoned and flooded. Overburden thickness is approximately 6 m (Parks 1914), most of which appears to be ablation till. Parks (1914) reported that this quarry was one of the most important in the Maritimes, and that the red sandstone produced from it was widely used throughout eastern Canada. Parks (1914, pp. 64-66) provides details pertaining to the technical quality of this stone.

H16-107 **UTM 933 775**

This site is another long abandoned, flooded quarry. The brown sandstone from this site was used primarily for grindstones, although a limited amount of building stone was produced (Parks 1914, pp. 61-63).

H16-108 **UTM 009 794**

The Trans-Canada Highway cuts through the flank of a large kame at this point. The road cut, approximately 6 m high, is slump covered. However, the material appears to consist of a silty fine sand with numerous cobbles and boulders, predominantly of sandstone. The aggregate potential of this deposit is limited, due to the poor quality of the material. Reserves are approximately 100,000 m^3.

H16-109 **UTM 031 846**

This quarry, approximately 3 to 5 m deep, exposes weathered conglomerates with interbeds of sandstone and shale. These conglomerates are similar to those to the west (H16-101). Some of the sandstone beds are unweathered and sound.

H16-110 **UTM 049 878**

DOT (1964) sampled a small deposit, probably of ice-contact origin, at this location. The boundaries of this deposit are indistinct, but the DOT data suggest that it is very small. Five out of six test holes exposed slightly silty to silty sand. The sixth encountered sandstone. The test results for this site were as follows:

86.2% to 100.0% passing 4.75 mm (average 96.3%),
4.0% to 17.7% passing 75 um (average 10.9%).

The material is therefore similar to that at H16-1. Reserves are minimal.

H16-111 **UTM 092 912**

This old, abandoned quarry exposes approximately 2 to 5 m of relatively hard sandstone. Outcrops adjacent to the quarry are striated (ranging from 195° to 205°; 202° average). Material from this area was crushed and subjected to the sodium sulphate test (DOT 1962). The material was found to have a high soundness loss. Results were as follows:

Size Range	Per cent Disintegration
25 - 38 mm	100.0
19 - 25 mm	100.0
12.7 - 19 mm	92.3 - 100.0
9.5 - 12.7 mm	84.0 - 100.0
4.75 - 9.5 mm	55.4 - 71.0

APPENDIX D

SITE DESCRIPTIONS

PORT ELGIN MAP AREA

21 I/1

LOCATION NO.:	I1-1	NTS:	21 I/1
TYPE OF DEPOSIT:	Marine shallow-water	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Shediac
STATUS:	Inactive	UTM:	916 190

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Silty; developed on the underlying material.

1.2 m Sand: Clean, well-sorted, cross-bedded fine to medium sand, with a few minor layers of very fine to fine gravel; a few thin silty bands are present near the base of the section; the bedding dips eastward.

0.8 m Slump Covered: Assumed to be sand as above; the base of the pit is at the water table.

In the western part of the pit, dense reddish brown clayey till is present near the surface.

DOT (1963) test results for the area are as follows (based on 6 samples):

between 97.5% and 100.0% passing 4.75 mm (average 99.0%),
between 3.5% and 10.1% passing 75 um (average 5.6%).

The material is suitable for use as a filter sand. The material in this deposit also has potential for blending with coarser material (ADI Limited 1975).

(CONTINUED)

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.			100.0	99.8	99.5	99.3	99.0	63.5	7.1	0.7

LITHOLOGIC ANALYSIS: N/A

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable	Limited

LOCATION #: I1-1 (cont'd)

The material sampled from this site typifies the finer material in the veneer of shallow-water marine sediment that lies between Shediac and Cap-Pelé. DOT (1962, 1963, 1964) data indicate that small pockets of similar materials are locally present in coastal areas further to the east (e.g., I1-105). This deposit overlies an undulating, till-mantled bedrock surface, and consequently is highly variable in thickness, and locally absent. It has a maximum thickness of approximately 3.5 m, but is generally less than 2 m thick. No evidence was found to indicate that glaciofluvial materials are present in the St-Henri-de-Barachois area, as outlined by Rampton and Paradis (1981a).

Kingston (1974) estimated that recoverable reserves in this deposit were in the order of 150,000 m^3. However, as pointed out by ADI Limited (1975, p. 34), those areas with a sufficient thickness of workable material "... are small, scattered, and interspersed with cottage development, making them unsuitable for normal scale commercial harvesting operations." Consequently, the deposit is considered to have only a limited potential as a source of granular aggregate materials.

LOCATION NO.:	I1-2	NTS:	21 I/1
TYPE OF DEPOSIT:	Marine shallow-water	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Shediac
STATUS:	Active-on-demand	UTM:	928 180

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Slightly silty; developed on the underlying material.

1.5 m Sandy Gravel: Clean fine to medium sand and medium to coarse gravel, with minor interbeds of very well sorted medium sand; clasts are subrounded to rounded.

The base of the above section lies at the water table. Elsewhere in this pit, Lohse (field notes, 1974) observed 2.4 m of interbedded gravelly sand and sand overlying a reddish clayey sandy silt till.

The neighbouring pit to the east (UTM 933 181) is similar in character, but with a higher sand content. Trough cross-bedding was observed in the upper portion of the material, while minor clay interbeds were present in the lower portion. Some coarser material is also present in this area, as indicated by the following DOT (1966) test results (or 2 samples):

82.5% and 67.7% passing 4.75 mm,
4.3% and 1.7% passing 75 um,
Los Angeles abrasion loss - 94.2%.

(CONTINUED)

MECHANICAL ANALYSIS (% passing):

sieve %	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
pass.	93.4	86.6	75.5	70.4	68.8	67.4	59.7	23.9	3.8	1.1
(partial)				100.0	97.7	95.7	84.8	33.9	5.4	1.6
Kingston (1974)				99			94			0.7

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 98%	Sound Lithotypes 2%
sandstone 98	sandstone 1; quartzite 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited

LOCATION #: I1-2 (cont'd)

The material sampled from this site typifies the coarser material in the veneer of shallow-water marine sediment that lies between Shediac and Cap-Pelé. The gravel is very friable and should be screened out if the material is to be put to high specification usage (Lohse 1974c).

The comments given for I1-1 regarding deposit variability and reserves also apply here.

I1-101 UTM 908 189

The presence of this quarry and others, within the limits of the shallow-water marine deposit graphically illustrates the limited potential that this marine deposit has as a source of aggregate. The exposed section consists of approximately 1 to 1.5 m of sandy gravel over about 1 m of dense reddish brown clayey till over 3 to 5 m of weathered and shattered sandstone. In the three quarries to the north, the sandy gravel appears to be thinner, and the till absent.

I1-102 UTM 840 976

Weathered conglomerate, with some interbeds of sandstone, is exposed in this quarry. It has been worked to a depth of 2 to 3 m at this site, and 4 to 5 m in the quarry to the south. The conglomerate is blanketed by till less than 1 m thick. This conglomerate is the best quality coarse aggregate known from within the Port Elgin map area.

I1-103 UTM 944 969

This site is an exposure of silty stony sand ablation till. This ablation till appears to be less silty than that to the south (see: H16-2) and without the reddish colour. However, it is still a very poor aggregate material, the component clasts being comprised almost totally of soft sandstones and siltstones. An erratic of sheared gabbro is present at the site; granitic erratics have been noted elsewhere within the deposit.

I1-104 UTM 149 057

This site is an abandoned and flooded sandstone quarry. The sandstone is overlain by approximately 1 m of till. This material was tested by DOT (1964), with the following results for two laboratory crushed samples:

36.8% and 41.4% passing 4.75 mm,
2.8% and 3.8% passing 75 um.
Los Angeles abrasion losses - 90.3% and 91.5%

The material was recommended as suitable only for use as borrow.

DOT (1959, 1962) testing of sandstone bedrock from several sites between Port Elgin and Hardy gave similar results.

Los Angeles abrasion losses ranged between 83.5% and 99.3%, with an average of 92.7%.

I5-105 **UTM 162 114**

This site is a former pit developed in a small shallow-water marine deposit. DOT (1962, 1963) tests provide the following information (based on 10 samples):

59.3% to 98.2% passing 4.75 mm (average (84.2%),
4.6% to 10.2% passing 75 um (average 7.1%).

The material was recommended for use as filter sand. Reserves are very limited.

APPENDIX E

SITE DESCRIPTIONS

MONCTON MAP AREA

21 I/2

LOCATION NO.:	I2-1	NTS:	21 I/2
TYPE OF DEPOSIT:	Ice-contact	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Moncton
STATUS:	Active-on-demand	UTM:	459 021

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Developed on the underlying material; estimated thickness.

5.5 m Gravel: Poorly sorted, cobbly medium to very coarse gravel, with a variable matrix (silty sand through to gravelly sand); minor interbeds of sand and gravelly sand are present; clasts are subrounded to well rounded; maximum clast size is 0.3 m.

The above section is in a subsidiary lift in the highest portion of the deposit. Maximum section heights in this area are approximately 20 m.

This deposit appears to be a large esker with associated ice-contact fans. In its lower portions it has been modified by the effects of marine submergence (i.e., erosion and burial by shallow-water sands). The material in the deposit is highly variable in texture, ranging from silty sand to coarse gravel (Lohse 1974e), though sandy gravel and gravel are predominant (Lohse, field notes, 1974).

The deposit was tested by DOT (1958), with the following results being reported (for 10 samples):

(CONTINUED)

MECHANICAL ANALYSIS (% passing):

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	82.0	51.3	49.2	37.4	29.9	23.1	17.4	11.1	7.4	5.7	4.5

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 92%	Sound Lithotypes 8%
sandstone 71; siltstone 21	felsic extrusive 6; quartzite 1; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
90	4	5	200,000

LOCATION #: I2-1 (cont'd)

21.3% to 56.1% passing 4.75 mm (average 34.2%),
0.5% to 1.6% passing 75 um (average 1.0%),
Los Angeles abrasion loss - 34.3% (average).

The material was recommended as suitable for borrow usage, and borderline for subbase usage. Kingston (1974) reported the following results from the analysis of a sand sample:

93% passing 4.75 mm,
60% passing 600 um,
4.6% passing 75 um.

Workable reserves in this deposit are largely depleted, and have been so for the last decade or more (Kingston 1974). The remaining exploitable reserves appear to be confined to four (4) small areas, only two (2) of which are currently adjacent to pit faces. Consequently, the deposit only has practical value as a source of material for local usage.

LOCATION NO.:	I2-2	NTS:	21 I/2
TYPE OF DEPOSIT:	Marine shallow-water	COUNTY:	Westmorland
EXPOSURE TYPE:	Pit	PARISH:	Dorchester
STATUS:	Active-on-demand	UTM:	691 973

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Developed on the underlying till.

0.5 - 1.0 m Till: Dense, reddish brown (5YR 4/3) sandy till; contains a number of boulders, including granites; maximum clast size is 0.6 m.

1.6 - 2.1 m Silty Sand: Predominantly fine to medium sand beds, with lesser medium to coarse sand beds and thin interbeds of clayey or sandy silt; the sand beds are 5 to 30 cm thick (the coarser beds are the thickest), and the silt beds are 1 to 3 cm thick; pebbles are rare.

The sand in this deposit appears to be of marine origin. The overlying till was probably deposited during a minor readvance of the glacier. The first pit to the north (UTM 693 981) exhibits a similar sequence: 2 to 3 m of till/1 to 1.5 m of silty to gravelly sand/conglomerate. The limited workable thickness of the sand, and its siltiness, plus the thickness of the overlying till, severely limits the aggregate potential of the material for uses other than as fill.

In the second, abandoned pit, to the north (UTM 691 985), 1.5 m of marine sand overlies till (Lohse, field notes, 1974). This material is probably of slightly younger age than that underlying till. Small pockets of similar material are present elsewhere in this portion of the Petitcodiac River valley (Lohse 1974d), but have no significant potential as aggregate sources.

MECHANICAL ANALYSIS (% passing):

sieve	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.		100.0	99.5	98.5	97.3	96.1	88.1	53.1	23.8	10.9

LITHOLOGIC ANALYSIS: N/A

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
65	20	1	200,000

I2-101 UTM 544 231

Lohse (field notes, 1974) described this small deposit as sandy ice-contact stratified drift, with numerous boulders on the surface. It probably contains only a limited volume of material.

I2-102 UTM 518 201

Approximately 1 m of sand overlying clay is exposed in this road cut. Sand is exposed at the surface along the road for several hundred metres downstream. This deposit probably has very limited aggregate potential.

The ablation till deposit to the west is a source of very poor quality aggregate. The material is a bouldery silty sandy angular sandstone gravel.

I2-103 UTM 470 137

This abandoned quarry, and the neighbouring one to the west, expose approximately 2 m of deeply weathered redbed conglomerates. The overburden of till appears to be generally less than 0.5 m thick.

The major rock types in the conglomerate are quartz, quartzites, felsic intrusives and extrusives, and mafic extrusives (DOT 1958). DOT (1958, 1963) testing of the two quarries provides the following results, based on 15 samples:

38.5% to 61.7% passing 4.75 mm (average 49.5%),
1.0% to 17.5% passing 75 um (average (8.0%),
Los Angeles abrasion loss - 27.4% to 41.4% (average 33.6%).

The material was recommended as suitable for borrow usage and locally borderline for subbase usage.

I2-104 UTM 553 138

Precambrian granitic rocks (Norman 1941) are crushed at this large quarry complex operated by Moncton Crushed Stone Limited. This operation is one of the major suppliers of high specification aggregate in southeastern New Brunswick (Hamilton

and Carroll 1975). Material from this site has been extensively tested by DOT. The following results are based on the 15 year period 1970 to 1984:

Los Angeles abrasion loss (125 samples) - 15.7% to 40.8% (average 23.9%, standard deviation 5.1%)

Sodium sulphate soundness loss (154 stone samples) - 1.00% to 59.43% (average 11.1%, standard deviation 8.1%)

In addition to crushed rock, manufactured fine concrete aggregate is produced by blending crusher-produced fines from this operation with natural sand (Carroll 1985) obtained from the Despres Lake esker to the west of Rogersville (Blackville map area; see Seaman 1983).

I2-105 **UTM 554 129**

This large quarry, developed in metasedimentary rocks (Lohse, field notes, 1974), is operated by H.E. Carson Limited. DOT (1976, 1977) data indicate that the early production from this site was of relatively soft material. Los Angeles abrasion losses for 39 samples averaged 46.8% (ranging from 34.3% to 59%). However, more recent data (DOT 1978-1982) indicate a significant improvement in quality, with an average Los Angeles abrasion loss, for 19 samples, of 28.5% (ranging from 20.4% to 37.3%), comparable to the granitic rocks to the north (I2-104) and near Gaytons (I2-118).

I2-106 **UTM 531 109**

A road cut through a tiny esker at this site exposes 0.6 to 2.4 m of gravelly sand to cobbly gravel. The material overlies till (Lohse, field notes, 1974). The aggregate potential of the deposit is minimal.

I2-107 **UTM 476 054**

Lohse (field notes, 1974) indicates that 0.9 m of silty sandy coarse gravel was present in an auger hole at this point in this tiny esker. Reserves are minimal.

I2-108 UTM 511 030

This site lies within an area of shallow scrapings and excavations in an ill-defined deposit of shallow-water marine origin. Lohse (field notes, 1974) reported that 1.5 to 2.5 m of fine to medium sand, overlying sandstone, was present in this area. However, at the time of the more recent visitation (during the latter part of July), the water table lay at a depth of 1 m at this site. Elsewhere throughout the area, the water table appeared to be at a depth of 1 m or less. Consequently, this deposit is not considered to have significant potential as a source of aggregate.

I2-109 UTM 540 007

This small deposit was mapped as a shallow-water marine deposit by Lohse (1974c). However, its position suggests that it is more likely a small outwash delta, formed at the mouth of Turtle Creek during the period of marine submergence. At least 1.5 m of sand is present at this site (Lohse, field notes, 1974). Lohse (field notes, 1974) indicates that the material to the west of this site is sand, while gravel is present in the smaller area to the east. Reserves of workable material in this deposit are limited by the residential development on its surface.

I2-110 UTM 533 978

This tiny, abandoned pit in a small outwash deposit exposes approximately 1 m of sandy gravel overlying 1 to 1.5 m of gravelly medium to coarse sand. Most of the gravel clasts consist of sandstone. Reserves in this deposit are minimal. Similar small deposits with local, limited aggregate potential may be present elsewhere in this portion of the Turtle Creek valley. One such deposit, near the reservoir dam was tested by DOT (1978). Test results, for 10 samples, were as follows:

75% to 99% passing 4.75 mm (average 92%),
1.8% to 5.8% passing 75 um (average 3.3%).

The material was recommended for use as filter and blending sand.

I2-111 UTM 572 029

This large, abandoned pit exposes up to 7 m of lodgment till overlying red shale and sandstone. In contrast, the quarry immediately to the north exposes less than 1 m of till overlying shattered sandstone.

Three samples of till were obtained from this site by DOT (1973) for analysis. Results were as follows:

70%, 89% and 93% passing 2.0 mm,
60%, 79% and 82% passing 475 um,
37.8%, 48.8% and 52.6% passing 75 um.

Two samples of similar material were obtained from a site approximately 3 km to the west, and five samples from 3 sites approximately 5 km to the northwest (DOT 1973), located south of Ryan Street. Combined results for these seven samples are as follows:

80% to 94% passing 2.0 mm (average 90%),
65% to 86% passing 475 um (average 78%),
34.4% to 56.7% passing 75 um (average 47.8%).

These tills are, therefore, sandy silts to silty sands, and are probably representative of most of the lodgment tills throughout the study area.

I2-112 UTM 682 206

A road cut in this small esker exposes approximately 1.5 m of slightly silty gravelly fine to medium sand overlying lodgment till (Lohse, field notes, 1974). In the road cut along the north-south road to the east, less than 1 m of sandy gravel overlies a dense, micaceous sand (possibly weathered sandstone). The gravel clasts consist predominantly of soft sandstone, and consequently the quality of the material is very poor.

Workable reserves in this deposit are limited. The value of this deposit as an aggregate source is well illustrated by the presence of an active-on-demand sandstone quarry immediately adjacent to the esker.

I2-113 UTM 809 168

This site is a sandstone quarry operated by Smith Cut Stone and Quarries Limited. This quarry has been a significant source of building stone, with current production primarily

being cut stone for restoration purposes (Carroll 1985). The quarry is approximately 23 m deep, with the upper 3 to 4 m being overburden (Parks 1914). The quality of the stone is described in detail by Parks (1914, p. 45-48).

I2-114 **UTM 787 115**

This small, largely abandoned quarry, approximately 2 to 3 m deep, exposes less than 1 m of till overlying weathered and shattered sandstones. DOT (1959) testing indicates a very high Los Angeles abrasion loss of 99.6%. A sandstone sample from another site in the Scoudouc area gave similar test results, with a Los Angeles abrasion loss of 96.2% (DOT 1959).

I2-115 **UTM 730 056**

This tiny deposit is a small kame. The road cut exposes approximately 1 m of sand and sandy gravel. The gravel clasts are predominantly soft sandstones. Reserves are minimal.

The currently inaccessible deposit to the southeast (UTM 749 033) appears to be a small crevasse filling. The material is probably similar to that described above. Reserves will be limited.

I2-116 **UTM 644 973**

This inactive quarry exposes 1 to 2 m of till overlying 2 to 4 m of shattered sandstone. The two quarries to the north, active-on-demand, expose similar materials, though the till cover in the northernmost is generally less than 1 m thick.

A sample of sandstone from this quarry was crushed by DOT (1962). The resulting aggregate had 14.7% passing 4.75 mm, 1.1% passing 75 um, and a low (for sandstone) Los Angeles abrasion loss of 57.5%. The material was recommended for use as borrow and as soil-cement aggregate.

Samples of similar material from the Dover area, to the east, were found to be softer (DOT 1961). For 4 samples, the results were as follows:

21.6% to 32.6% passing 4.75 mm (average 28.5%),
1.3% to 2.0% passing 75 um (average 1.7%),
Los Angeles abrasion loss - 63.9% to 84.6% (average 77.6%).

I2-117 UTM 711 957

This small quarry exposes a very thin till overlying up to 5 m of weathered conglomerate with minor sandstone interbeds. Similar materials are exposed in the quarry to the west (UTM 695 968), approximately 3 to 7 m deep, and in the shallower (approximately 2 m deep) quarries to the east (UTM's 732 965, 736 965, 737 963). The pebbles in these conglomerates are predominantly volcanics, quartzite, and quartz, and are similar to those elsewhere in this general area (see H15-115, H16-101).

I2-118 UTM 789 004

Precambrian granite gneiss is crushed in this large quarry complex operated by Acadia Crushed Stone Limited (Hamilton and Carroll 1975). Extensive testing by DOT of material from this site provides the following results (for the 15 year period 1970 to 1984):

Los Angeles abrasion loss (48 samples) -
22.0% to 39.2% (average 29.2%, standard deviation 5.0%)
Sodium sulphate soundness loss (50 stone samples) -
0.23% to 35.57% (average 7.53%, standard deviation 7.01%).

Materials from the neighbouring granite quarries to the west of the Memramcook River (Dexter Construction Limited and MacDonald's Paving and Construction Limited) have also been tested by DOT The results for the same 15 year period, are as follows:

Los Angeles abrasion loss (39 samples) -
20.7% to 56.1% (average 31.2%, standard deviation 7.3%)
Sodium sulphate soundness loss (34 stone samples) -
1.03% to 42.09% (average 9.22%, standard deviation 8.32%).

As with the similar quarry at Moncton (I2-104), these quarries are major suppliers of high specification aggregate in southeastern New Brunswick.

Sandstones in the vicinity of the granite body are of typical poor quality. DOT (1959) indicates Los Angeles abrasion losses of 79.4% and 88.2% for samples from the Calhoun area, just to the north.

I2-119 UTM 791 994

A small exposure in this overgrown excavation exhibits approximately 1 m of very fine to fine sand with minor pebbles and silty bands. Lohse (field notes, 1974) indicates that the material varies from sand through to sandy gravel with a few cobbles up to 0.3 m in size. The deposit is probably a tiny delta. Reserves are minimal, as till is present, under a thin veneer of marine sand, along the adjacent highway.

MAPS NOT

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